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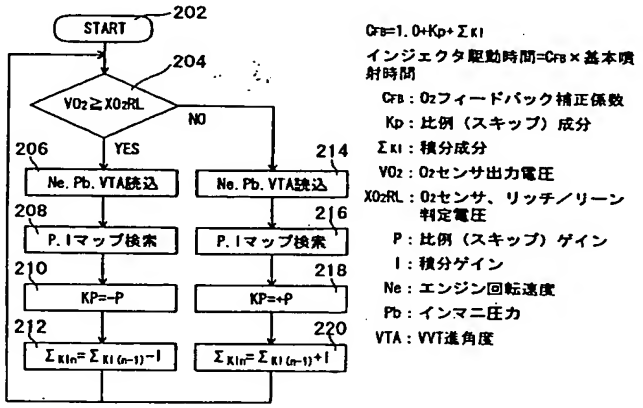
最終頁に続く

(54)【発明の名称】内燃機関の空燃比制御装置

(57)【要約】
【目的】　本発明は、バルブタイミングの進角量の値が大きくなるに連れて、フィードバック補正量の補正幅を漸次小さくし、空燃比の変動量が大きくなることはないとともに、空燃比の振れ幅も小さくなり、サージの発生も抑制できることを目的としている。
【構成】　このため、内燃機関空燃比制御装置において、空燃比検出手段からの値に基づいて、基本制御量を補正するためのフィードバック補正量を算出し、実際の空燃比を目標空燃比に近づけるべく制御する制御手段を設けるとともに、制御手段には、バルブタイミングの進角量の値が大きくなるに連れて、フィードバック補正量の補正幅を漸次小さくする機能を付加して設けている。



【００１１】しかし、触媒が最も有効に働く空燃比の振れは、内燃機関の運転条件（エンジン負荷や回転速度等）によって異なる。

【００１２】また、触媒が最も有効に働く空燃比の振れでは、空燃比の変動に伴ってエンジン出力トルクも大きく変動し、サージが発生してしまう運転領域が存在するという不具合がある。

【００１３】このような不具合を解消する方策の１つとして、Ｏ２フィードバック制御の積分ゲインと比例ゲインとをエンジン回転速度と吸気管圧力（「インマニ圧力」ともいう）とをパラメータに持つマップにすることが行われている。

【００１４】これにより、内燃機関の運転条件に応じて最も有効に触媒が働く空燃比の振れを実現できるとともに、空燃比変動に対してトルク変動の大きい運転領域では、積分ゲインと比例ゲインとを小さく設定でき、サージを防止することも可能となるものである。

【００１５】しかしながら、ＶＶＴ等の吸排気バルブタイミングが可変する内燃機関においては、カムの位相によって内燃機関の特性が大きく変化する。

【００１６】つまり、図９に示す如く、同一エンジン回転速度、同一吸気管圧力であっても、ＶＶＴ進角量によって空燃比変化に対するトルクの変動幅に大きな差が出る領域がある。

【００１７】このような領域では、ＶＶＴ進角量が小さい時に触媒が有効に働くようにある程度大きなフィードバック制御の積分ゲインと比例ゲインとを設定すると、ＶＶＴ進角量が大きくなった時に、フィードバック制御による空燃比変動により、図１０に示す如く、トルク変動が発生し、サージ感が出てしまい、実用上不利であるという不都合がある。

【００１８】

【課題を解決するための手段】そこで、この発明は、上述不都合を除去するために、内燃機関に燃料を供給する燃料噴射手段と、空燃比を検出する空燃比検出手段と、吸気バルブと排気バルブとが共に開弁するバルブオーバラップ期間を変更可能な可変バルブタイミング手段とを備えた内燃機関空燃比制御装置において、前記空燃比検出手段からの値に基づいて、基本制御量を補正するためのフィードバック補正量を算出し、実際の空燃比を目標空燃比に近づけるべく制御する制御手段を設けるとともに、この制御手段には、バルブタイミングの進角量の値が大きくなるに連れて、フィードバック補正量の補正幅を漸次小さくする機能を付加して設けたことを特徴とする。

【００１９】

【発明の実施の形態】上述の如く発明したことにより、制御手段が、空燃比検出手段からの値に基づいて、基本制御量を補正するためのフィードバック補正量を算出し、実際の空燃比を目標空燃比に近づけるべく制御するとともに、バルブタイミングの進角量の値が大きくなるに連れて、フィードバック補正量の補正幅を漸次小さくしている。

【００２０】

【実施例】以下図面に基づいてこの発明の実施例を詳細に説明する。

【００２１】図１～図５はこの発明の第１実施例を示すものである。図３において、２は図示しない車両に搭載された内燃機関（「エンジン」ともいう）、４はシリンダブロック、６はシリンダヘッド、８はヘッドカバー、１０はピストン、１２は燃焼室、１４は吸気ポート、１６は排気ポート、１８は吸気バルブ、２０は排気バルブである。

【００２２】内燃機関２は、吸気系としてエアクリーナ２２と吸気管２４とスロットルボディ２６とサージタンク２８と吸気マニホルド（「インテークマニホルド」ともいう）３０とを順次に接続し、吸気ポート１４に連通する吸気通路３２を設けている。スロットルボディ２６の吸気通路３２には、スロットルバルブ３４を設けている。

【００２３】このとき、前記吸気管２４途中には、上流側からターボチャージャ３６のコンプレッサ３８と、インタクーラ４０とを順次配設する。

【００２４】また、内燃機関２は、排気系として排気マニホルド（「エキゾーストマニホルド」ともいう）４２と排気管４４と触媒コンバータ４６とを順次に接続し、排気ポート１６に連通する排気通路４８を設けている。触媒コンバータ４６内には、触媒５０を設けている。

【００２５】そして、前記排気管４４途中に、前記ターボチャージャ３６のタービン５２を配設するとともに、このタービン５２をバイパスするウエストゲート通路５４を設け、ウエストゲート通路５４途中にはウエストゲートバルブ５６を設ける。

【００２６】前記内燃機関２は、ヘッドカバー８にＰＣＶバルブ５８を取り付けて設け、このＰＣＶバルブ５８を介してヘッドカバー８内とサージタンク２８の吸気通路３２とを連通する第１ブローバイガス通路６０を設け、ヘッドカバー８内とスロットルボディ２６よりも上流側の吸気通路３２とを連通する第２ブローバイガス通路６２を設けている。

【００２７】前記内燃機関２は、シリンダヘッド６に燃焼室１２に指向させて燃料噴射手段である燃料噴射弁（「インジェクタ」ともいう）６４を設けている。この燃料噴射弁６４は、燃料供給通路６６により燃料タンク６８に連絡されている。燃料タンク６８内には、燃料供給通路６６に燃料を送給する燃料ポンプ（「フューエルポンプ」ともいう）７０を設けている。燃料タンク６８内の燃料供給通路６６の途中には、燃料フィルタ７２と、燃料圧力を調整するプレッシャレギュレータ７４とを設けている。

のＰ．Ｉ．ゲインマップを検索（２０８）する。

【００４４】また、Ｐ．Ｉ．ゲインマップの検索処理（２０８）の後に、比例（スキップ）成分ＫＰを「－Ｐ」（Ｐ：比例（スキップ）ゲイン）とし（２１０）、式

ΣＫＩｎ＝ΣＫＩ（ｎ－１）－Ｉ

Ｉ：積分ゲイン

によって、積分成分ΣＫＩｎを算出（２１２）し、上述したＯ２センサ・リッチ／リーン判定電圧ＸＯ２ＲＬ以上であるか否かの判断（２０４）に戻る。

【００４５】なお、前記フィードバック補正量であるＯ２フィードバック補正係数ＣＦＢは、式

ＣＦＢ＝１．０＋ＫＰ＋ΣＫＩ

によって算出され、インジェクタ駆動時間は、Ｏ２フィードバック補正係数ＣＦＢと基本噴射時間との積によって求められる。

【００４６】更に、上述したＯ２センサ・リッチ／リーン判定電圧ＸＯ２ＲＬ以上であるか否かの判断（２０４）がＮＯの場合には、エンジン回転速度Ｎｅや吸入空気圧力（「インマニ圧力」ともいう）Ｐｂ、ＶＶＴ進角量ＶＴＡを読み込み（２１４）、図２の（ａ）～（ｃ）に夫々示す３個のＰ．Ｉ．ゲインマップを検索（２１６）する。

【００４７】このＰ．Ｉ．ゲインマップの検索処理（２１６）の後に、比例（スキップ）成分ＫＰを「＋Ｐ」（Ｐ：比例（スキップ）ゲイン）とし（２１８）、式

ΣＫＩｎ＝ΣＫＩ（ｎ－１）＋Ｉ

によって、積分成分ΣＫＩｎを算出（２２０）し、上述したＯ２センサ・リッチ／リーン判定電圧ＸＯ２ＲＬ以上であるか否かの判断（２０４）に戻る。

【００４８】これにより、前記制御手段１１２によって、図５に示す如く、バルブタイミングの進角量であるＶＶＴ進角量ＶＴＡの値が大きくなるに連れて、フィードバック補正量であるＯ２フィードバック補正係数ＣＦＢの補正幅を漸次小さくすることができ、空燃比の変動量が大きくなることはないとともに、空燃比の振れ幅も小さくなり、サージの発生も抑制でき、実用上有利である。

【００４９】また、前記制御手段１１２により算出されるフィードバック補正量を、比例成分と積分成分とからなる構成としたことにより、比例成分や積分成分の値を、バルブタイミングの進角量であるＶＶＴ進角量ＶＴＡに応じて変更するのみで良く、制御上も簡単に実施可能であり、且つ応答性も良く、商品力の向上に貢献し得るものである。

【００５０】図６及び図７は、この発明の第２実施例を示すものである。

【００５１】この第２実施例において、上述の第１実施例のものと同一機能を果たす箇所には、同一符号を付して説明する。

【００５２】この第２実施例の特徴とするところは、ＶＶＴ進角量ＶＴＡによってＶＶＴ積分ゲイン補正係数及びＶＶＴ比例ゲイン補正係数を求めるＶＴＡ補正テーブルを設定した点にある。

【００５３】すなわち、ＶＴＡ補正テーブルを、図７（ａ）に示す如く、ＶＶＴ進角量ＶＴＡからＶＶＴ積分ゲイン補正係数ＣＶＴＡを求めるものと、図７（ｂ）に示す如く、ＶＶＴ進角量ＶＴＡからＶＶＴ比例ゲイン補正係数ＣＶＴＡＰを求めるものとの２つを設ける。このとき、各ＶＴＡ補正テーブルは、ＶＶＴ進角量ＶＴＡが増加するに連れて、漸次減少すべく設定される。

【００５４】概ね、ＶＶＴ進角量ＶＴＡが小さい時の方が、ＶＶＴ進角量ＶＴＡが大きい時よりも空燃比変動に対するトルクの変動が小さいため、ＶＶＴ進角量ＶＴＡから求まる補正係数をＯ２フィードバックの積分ゲイン、比例ゲインに乗じることにより、低進角時は各ゲインを大きく高進角時は逆に小さく制御する。

【００５５】ここで、図６の制御用フローチャートに沿って作用を説明する。

【００５６】前記空燃比制御装置の制御手段の制御用プログラムがスタート（３０２）すると、ＶＶＴ進角量ＶＴＡの読み込み（３０４）が行われるとともに、ＶＴＡ補正テーブルの検索（３０６）が行われ、Ｏ２センサのＯ２センサ出力電圧ＶＯ２がＯ２センサ・リッチ／リーン判定電圧ＸＯ２ＲＬ以上であるか否かの判断（３０８）を行う。

【００５７】そして、この判断（３０８）がＹＥＳの場合には、比例（スキップ）成分ＫＰを「－ＣＶＴＡＰ・Ｐ」（ＣＶＴＡＰ：ＶＶＴ比例ゲイン補正係数、Ｐ：比例（スキップ）ゲイン）とし（３１０）、式

ΣＫＩｎ＝ΣＫＩ（ｎ－１）－ＣＶＴＡ・Ｉ

Ｉ：積分ゲイン

によって、積分成分ΣＫＩｎを算出（３１２）し、上述したＶＶＴ進角量ＶＴＡの読み込み（３０４）に戻る。

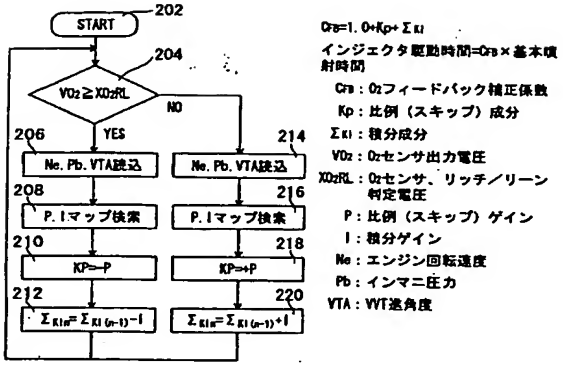
【００５８】また、上述のＯ２センサのＯ２センサ出力電圧ＶＯ２がＯ２センサ・リッチ／リーン判定電圧ＸＯ２ＲＬ以上であるか否かの判断（３０８）において、この判断（３０８）がＮＯの場合には、比例（スキップ）成分ＫＰを「＋ＣＶＴＡＰ・Ｐ」とし（３１４）、式

ΣＫＩｎ＝ΣＫＩ（ｎ－１）＋ＣＶＴＡ・Ｉ

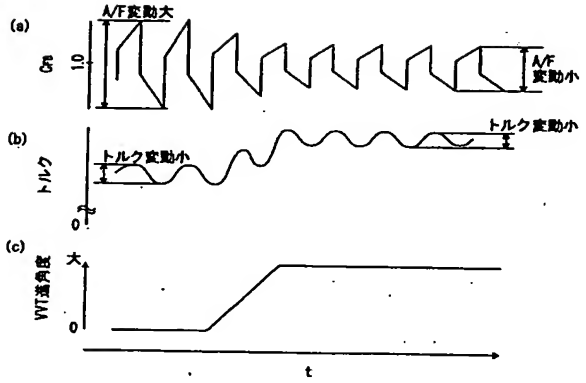
によって、積分成分ΣＫＩｎを算出（３１６）し、上述したＶＶＴ進角量ＶＴＡの読み込み（３０４）に戻る。

【００５９】さすれば、上述第１実施例のものと同様に、前記制御手段によって、バルブタイミングの進角量であるＶＶＴ進角量ＶＴＡの値が大きくなるに連れて、フィードバック補正量であるＯ２フィードバック補正係数ＣＦＢの補正幅を漸次小さくすることができ、空燃比の変動量が大きくなることはないとともに、空燃比の振れ幅も小さくなり、サージの発生も抑制でき、実用上有利である。

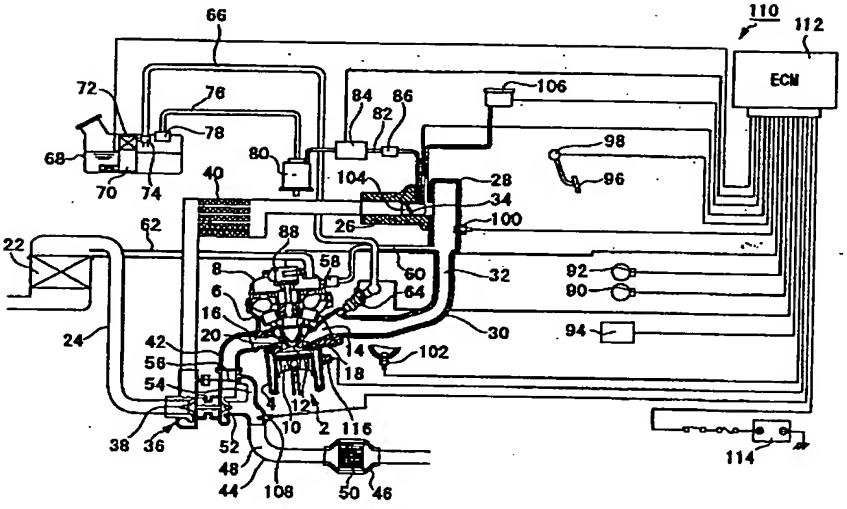
【図１】


START
202
204
VO2≧XO2RL
NO
YES
206
214
Ne. Pb. VTA読込
208
216
P. Iマップ検索
210
218
KP=→P
212
220
ΣKIn=ΣKI(n-1)-I
ΣKIn=ΣKI(n-1)+I
Cfb=1. 0+Kp+ΣKI
インジェクタ駆動時間=Cfb×基本噴射時間
Cfb：O2フィードバック補正係数
Kp：比例（スキップ）成分
ΣKI：積分成分
VO2：O2センサ出力電圧
XO2RL：O2センサ、リッチ／リーン判定電圧
P：比例（スキップ）ゲイン
I：積分ゲイン
Ne：エンジン回転速度
Pb：インマニ圧力
VTA：VVT進角度

【図５】


(a)
A/F
A/F変動大
1.0
A/F変動小
(b)
トルク
トルク変動小
トルク変動小
0
(c)
VVT進角度
大
0
t

【図３】


66
110
112
ECM
72
76
78
68
70
74
80
84
86
82
106
98
96
104
28
34
100
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62
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32
92
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24
42
56
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14
102
18
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4
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2
116
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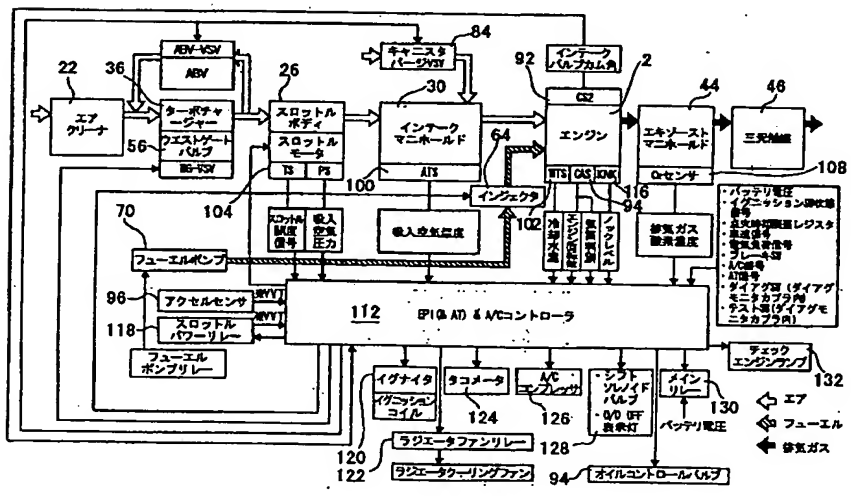
48
44
108
50
46
114

【図４】


ABV-VSV
ABV
84
キャニスタパージVSV
インテークバルブカム角
92
2
22
36
26
30
CO2
44
46
エアクリーナ
ターボチャージャー
スロットルボディ
インテークマニホールド
エンジン
エキゾーストマニホールド
三元触媒
56
ウエストゲートバルブ
スロットルモータ
64
108
BG-VSV
TS
PS
ATS
WTS
CAS
KNK
O2センサ
100
インジェクタ
116
94
104
70
スロットル開度信号
吸入空気圧力
吸入空気温度
102
エンジン回転数
冷却水温
ノックレベル
排気ガス酸素濃度
フューエルポンプ
アクセルセンサ
96
118
スロットルパワーリレー
フューエルポンプリレー
112
EFI(& AT) & A/Cコントローラ
チェックエンジンランプ
132
イグナイタ
イグニッションコイル
タコメータ
124
A/Cコンプレッサ
126
シフトソレノイドバルブ
O/D OFF表示灯
メインリレー
130
バッテリ電圧
エア
フューエル
排気ガス
ラジエータファンリレー
120
122
128
ラジエータクーリングファン
94
オイルコントロールバルブ

PATENT ABSTRACTS OF JAPAN

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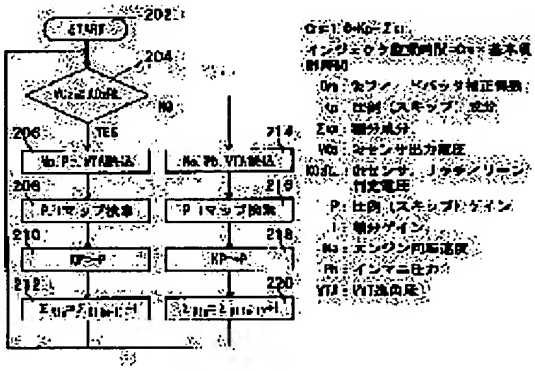
(54) AIR-FUEL RATIO CONTROL DEVICE FOR INTERNAL COMSUTION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the increase in fluctuating quantity of air-fuel ratio, minimize the fluctuating width of air-fuel ratio and suppress the generation of surge by gradually minimizing the correction width of feedback correction quantity according to the increase in advance value of valve timing.
SOLUTION: This air-fuel ratio control device for internal combustion engine comprises a control means for calculating the feedback correction quantity for correcting a basic control quantity on the basis of the value from an air-fuel ratio detecting means and controlling the actual air-fuel ratio to be close to an intended air-fuel ratio. The control means is additionally provided with a function for gradually minimizing the correction width of feedback correction quantity according to the increase in advance value of valve timing.



LEGAL STATUS

[Date of request for examination]

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[Date of registration]

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] A fuel-injection means to supply a fuel to an internal combustion engine, and an air-fuel ratio detection means to detect an air-fuel ratio, In the internal combustion engine air-fuel ratio control system equipped with an adjustable valve timing means by which the bulb overlap period which both an intake valve and an exhaust air bulb open can be changed While establishing the control means controlled in order to compute the amount of feedback amendments for amending the amount of basic control based on the value from said air-fuel ratio detection means and to bring a actual air-fuel ratio close to a target air-fuel ratio The air-fuel ratio control system of the internal combustion engine characterized by adding and preparing the function in which the value of the amount of tooth lead angles of valve timing takes for becoming large, and makes small gradually amendment width of face of the amount of feedback amendments in this control means.
[Claim 2] The amount of feedback amendments computed by said control means is the air-fuel ratio control system of the internal combustion engine according to claim 1 which consists of a proportion component and an integral component.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention is equipped with an adjustable valve-timing means to by_which the bulb overlap period which an internal combustion engine's air-fuel ratio control system takes, especially both an intake valve and an exhaust-air bulb open can change, and it relates to the air-fuel ratio control system of the internal combustion engine which controls generating of a surge by making deflection width of face of an air-fuel ratio into smallness while the value of the amount of tooth lead angles of valve timing takes for becoming large, controls the amendment width of face of the amount of feedback amendments by the control means and controls the amount of an air-fuel ratio of fluctuation by it.
[0002]
[Description of the Prior Art] In an internal combustion engine, O2 sensor which detects the oxygen density in an air-fuel ratio detection means, for example, exhaust gas, to detect an air-fuel ratio in an exhaust air system is formed, and there is a thing equipped with the air-fuel ratio control system which carries out feedback control of the air-fuel ratio by the detecting signal from this O2 sensor.
[0003] There are some which are indicated by JP,7-238855,A as an internal combustion engine's air-fuel ratio control system. The air-fuel ratio control system of an internal combustion engine with a bulb property switching unit indicated by this official report The bulb property means for switching which switches the closing motion property of an intake valve or an exhaust air bulb based on an engine's operational status, engine inhalation -- the signal from an air-fuel ratio detection means to detect the air-fuel ratio of gaseous mixture, and an air-fuel ratio detection means -- being based -- engine inhalation -- with an amount setting-out means of feedback amendments to set up the amount of feedback amendments to the amount of basic control so that the air-fuel ratio of gaseous mixture may be brought close to a target air-fuel ratio In the air-fuel ratio control system of the internal combustion engine with a bulb property switching unit having an amount setting-out means of Air Fuel Ratio Control to amend the amount of basic control based on the amount of feedback amendments, and to set up the amount of air-fuel ratio amendments the change-over signal of a bulb property means for switching -- responding -- engine inhalation -- that the air-fuel ratio of gaseous mixture should be changed It had an amount modification setting-out means of feedback amendments to change and set up the amount of feedback amendments, and has prevented that the exhaust air emission based on the response delay and fault amendment at the time of a bulb property change-over gets worse.
[0004] Moreover, there are some which are indicated by JP,8-291753,A. An internal combustion engine's fuel-injection control unit indicated by this official report While calculating a feedback correction factor from an adaptive control rule, the PID-control rule which is inferior to it in responsibility, having embraced operational status, choosing whether it is a gap and amending fuel oil consumption based on a selection value When the valve timing by the side of a high speed is chosen Amend with the feedback correction factor by the PID-control rule, and it avoids that a level difference arises and a control input changes suddenly between feedback correction factors. Also when the valve timing by the side of a high speed is chosen in the adjustable valve timing device, the controllability of fuel injection thru/or an air-fuel ratio is raised securing the stability of control.
[0005]
[Problem(s) to be Solved by the Invention] By the way, in the conventional internal combustion engine's air-fuel ratio control system, general PI control is explained along with the flow chart of drawing 8 also in O2

feedback control.
[0006] if the program for control of the control means of said air-fuel ratio control system starts (402) -- 2OO2 sensor output voltage VO2 sensor - of O2 sensor -- rich -- it judges whether it is more than /Lean judging electrical-potential-difference XO2RL (404).
[0007] and O2 sensor - which set the proportion (skip) component KP to "-P" (P: proportion (skip) gain) (406), computed integral component sigmaKIn according to formula sigma KIn=sigma KI(n-1)-II:integral gain (408), and was mentioned above when this decision (404) was YES -- rich -- it returns to decision (404) whether it is more than /Lean judging electrical-potential-difference XO2RL.
[0008] In addition, O2 feedback correction factor CFB which is said amount of feedback amendments is computed by formula CFB=1.0+ KP+sigma KI, and injector actuation time amount is found by the product of O2 feedback correction factor CFB and basic injection time.
[0009] furthermore, when decision (404) whether it is or not is NO more than RL [O2 sensor Rich / Lean judging electrical-potential-difference XO2RL] it mentioned above The proportion (skip) component KP is set to "+P" (P: proportion (skip) gain) (410). By formula sigma KIn=sigma KI(n-1)+I More than RL [O2 sensor Rich / Lean judging electrical-potential-difference XO2RL] it computed and (412) mentioned integral component sigmaKIn above, it returns to decision (404) whether it is or not.
[0010] In O2 feedback control, integral gain and proportional gain conform so that the deflection of the air-fuel ratio which a catalyst commits effectively most fundamentally may be acquired.
[0011] However, the deflection of the air-fuel ratio which a catalyst commits most effectively changes with an internal combustion engine's service conditions (an engine load, rotational speed, etc.).
[0012] Moreover, by the deflection of the air-fuel ratio which a catalyst commits most effectively, with fluctuation of an air-fuel ratio, an engine output torque is also changed sharply and has the nonconformity that the operating range which a surge generates exists.
[0013] Using the integral gain and proportional gain of O2 feedback control as the map which has an engine speed and the pressure-of-induction-pipe force (it is also called a "IMMANI pressure") in a parameter as one of the policies which cancel such nonconformity is performed.
[0014] While the deflection of the air-fuel ratio which a catalyst commits most effectively according to an internal combustion engine's service condition is realizable by this, to air-fuel ratio fluctuation, by the large operating range of torque fluctuation, integral gain and proportional gain can be set up small and it also becomes possible to prevent a surge.
[0015] However, in the internal combustion engine with which pumping valve timing, such as VVT, carries out adjustable, an internal combustion engine's property changes with the phases of a cam a lot.
[0016] That is, as shown in drawing 9 , even if it is the same same engine-speed and pressure-of-induction-pipe force, there is a field out of which a big difference comes to the range of fluctuation of torque to air-fuel ratio change with the amount of VVT tooth lead angles.
[0017] In such a field, when the amount of VVT tooth lead angles was small, the integral gain and proportional gain of to some extent big feedback control were set up so that a catalyst might work effectively and the amount of VVT tooth lead angles becomes large, by air-fuel ratio fluctuation by feedback control, as shown in drawing 10 , torque fluctuation occurs, a feeling of a surge comes out, and there is inconvenience that it is disadvantageous practically.
[0018]
[Means for Solving the Problem] Then, a fuel-injection means to supply a fuel to an internal combustion engine in order that this invention may remove the above-mentioned inconvenience, In the internal combustion engine air-fuel ratio control system equipped with an adjustable valve timing means by which the bulb overlap period which both an air-fuel ratio detection means to detect an air-fuel ratio, and an intake valve and an exhaust air bulb open can be changed While establishing the control means controlled in order to compute the amount of feedback amendments for amending the amount of basic control based on the value from said air-fuel ratio detection means and to bring a actual air-fuel ratio close to a target air-fuel ratio The value of the amount of tooth lead angles of valve timing takes for becoming large, and is characterized by adding and preparing the function which makes small gradually amendment width of face of the amount of feedback amendments at this control means.
[0019]

[Embodiment of the Invention] While a control means controls by having invented like **** based on the value from an air-fuel ratio detection means so that it may compute the amount of feedback amendments for amending the amount of basic control and may bring a actual air-fuel ratio close to a target air-fuel ratio, the value of the amount of tooth lead angles of valve timing takes for becoming large, and makes small gradually amendment width of face of the amount of feedback amendments.
[0020]
[Example] Based on a drawing, the example of this invention is explained to a detail below.
[0021] Drawing 1 - drawing 5 show the 1st example of this invention. the internal combustion engine (it is also called an "engine") carried in the car which 2 does not illustrate in drawing 3 , and 4 -- a cylinder block and 6 -- the cylinder head and 8 -- for a combustion chamber and 14, as for an exhaust port and 18, an inlet port and 16 are [a cylinder-head cover and 10 / a piston and 12 / an intake valve and 20] exhaust air bulbs.
[0022] The internal combustion engine 2 connected an air cleaner 22, the inlet pipe 24, the throttle body 26, the surge tank 28, and the inlet manifold (it is also called an "intake manifold") 30 one by one as an inhalation-of-air system, and has formed the inhalation-of-air path 32 which is open for free passage to an inlet port 14. The throttle valve 34 is formed in the inhalation-of-air path 32 of a throttle body 26.
[0023] At this time, sequential arrangement of the compressor 38 of a turbocharger 36 and the intercooler 40 is carried out from the upstream in the middle of said inlet-pipe 24.
[0024] Moreover, the internal combustion engine 2 connected the exhaust manifold (it is also called a "exhaust manifold") 42, the exhaust pipe 44, and the catalytic converter 46 one by one as an exhaust air system, and has formed the flueway 48 which is open for free passage to an exhaust port 16. The catalyst 50 is established in the catalytic converter 46.
[0025] And while arranging the turbine 52 of said turbocharger 36 in the middle of said exhaust pipe 44, the waist gate path 54 which bypasses this turbine 52 is formed, and the waist gate valve 56 is formed in the middle of waist gate path 54.
[0026] Said internal combustion engine 2 attached and formed PCV valve 58 in the cylinder-head cover 8, formed the 1st blow-by gas path 60 which opens the inhalation-of-air path 32 of a surge tank 28 for free passage in a cylinder-head cover 8 through this PCV valve 58, and has formed the 2nd blow-by gas path 62 which opens the inhalation-of-air path 32 of the upstream for free passage rather than a throttle body 26 in the cylinder-head cover 8.
[0027] Said internal combustion engine 2 made the cylinder head 6 direct in a combustion chamber 12, and has formed the fuel injection valve (it is also called a "injector") 64 which is a fuel-injection means. This fuel injection valve 64 is connected to the fuel tank 68 by the fuel-supply path 66. In the fuel tank 68, the fuel pump (it is also called a "fuel pump") 70 which feeds a fuel into the fuel-supply path 66 is formed. In the middle of the fuel-supply path 66 in a fuel tank 68, the fuel filter 72 and the pressure regulator 74 which adjusts fuel pressure are formed.
[0028] In said fuel tank 68, the end side of the EBAPO path 76 is opened for free passage through 2 way check valve 78. The other end side of the EBAPO path 76 is opened for free passage by the canister 80. The end side of the purge path 82 is opened for free passage in this canister 80. The other end side of the purge path 82 is open for free passage from the throttle valve 34 to the inhalation-of-air path 32 of the downstream.
[0029] And in the middle of this purge path 82, sequential arrangement of the canister purge valve (VSV) 84 and the 1 way bulb 86 is carried out from a canister 80 side.
[0030] The ignition coil 88 which flies and carries out fire to the ignition plug which is not illustrated is prepared for said internal combustion engine 2. The crank angle sensor 90 which detects the crank angle and engine speed for cylinder distinction is formed. Form the cam angle sensor 92 which detects the include angle of the cam which is not illustrated, and the VVT oil control valve 94 which controls VVT (adjustable valve timing device) is formed. The accelerator sensor 98 which detects the amount of treading in of an accelerator pedal 96 is formed. Form the intake temperature sensor 100 which detects inhalation air temperature, and the coolant temperature sensor 102 which detects an internal combustion engine's 2 circulating water temperature is formed. The throttle sensor 104 which detects the throttle opening of a throttle valve 34 is formed. The pressure sensor 106 which detects the inhalation air pressure in the inhalation-of-air path 32 is connected and formed in the upstream of said surge tank 28. O2 sensor 108 which detects the oxygen density in an air-fuel ratio detection means, for example, exhaust gas, to detect an air-fuel ratio is formed in the flueway 48 of the downstream rather

than the unification part with said waist gate path 54.
[0031] Said fuel injection valve 64, fuel pump 70, ignition coil 88 and crank angle sensor 90, the cam angle sensor 92, the VVT oil control valve 94, the accelerator sensor 98, the intake temperature sensor 100, the coolant temperature sensor 102, the throttle sensor 104, and pressure-sensor 106 andO2 sensor 108 are connected to the control means (it is also called "ECM") 112 which constitutes an air-fuel ratio control system 110. In addition, it is the knock sensor with which a sign 114 outputs a dc-battery and 116 outputs NOKKUREBERU **.
[0032] Moreover, besides what was mentioned above, if said air-fuel ratio control system 110 is explained along with the system flowchart of drawing 4 , while battery voltage, an ignition-switch condition signal, an ignition timing adjustment register, a vehicle speed signal, an electric load signal, an A/C signal, and AT signal are inputted, the brake switch which is not illustrated, the DAIAGU switch (diamond GUMONI hawk plastic **), and the test switch (diamond GUMONI hawk plastic **) are connected to said control means 112.
[0033] Furthermore, in said control means 112, they are the throttle power relay 118, an ignitor 120 and the radiator fan relay 122, a tachometer 124, the A/C compressor 126, and a shift solenoid valve and O/D. The OFF indicating lamp 128, main relay 130, and check engine lamp 132 grade are connected.
[0034] At this time, said air-fuel ratio control system 110 is equipped with an adjustable valve timing means which is not illustrated by which the bulb overlap period which both an intake valve 18 and the exhaust air bulb 20 open can be changed. It is based on a value from said air-fuel ratio detection means 108, for example, O2 sensor. While establishing said control means 112, the function controlled in order to compute the amount of feedback amendments for amending the amount of basic control and to bring a actual air-fuel ratio close to a target air-fuel ratio The value of the amount of tooth lead angles of valve timing takes for becoming large, and also considers the function which makes small gradually amendment width of face of the amount of feedback amendments as the configuration which adds and prepares at this control means 112.
[0035] If it explains in full detail, said control means 112 computes O2 feedback correction factor CFB which is the amount of feedback amendments for amending the amount of basic control based on O2 sensor output voltage VO2 which is a value from O2 sensor 108, and it will control it so that it may bring a actual air-fuel ratio close to a target air-fuel ratio.
[0036] Moreover, as said control means 112 is shown in drawing 5 , the value of the amount VTA of VVT tooth lead angles which is the amount of tooth lead angles of valve timing takes for becoming large, and also has the function to make small gradually amendment width of face of O2 feedback correction factor CFB which is the amount of feedback amendments.
[0037] And the amount of feedback amendments computed by said control means 112 consists of a proportion component and an integral component.
[0038] Furthermore, it has the proportional gain and integral gain of the amount of feedback amendments which are computed by said control means 112 for each amount of VVT tooth lead angles.
[0039] Since said internal combustion engine's 2 property changes with the amounts of VVT tooth lead angles a lot, it realizes the deflection of the air-fuel ratio which uses the proportional gain and the integral gain map corresponding to the amount of VVT tooth lead angles (it is also called "P. I. gain map"), and loses a feeling of a surge by each operating range, and a catalyst 50 commits most efficiently in the small field of fluctuation of the torque by air-fuel ratio fluctuation.
[0040] In this 1st example, three P.I. gain maps are set as (a) - (c) of drawing 2 according to the amount VTA of VVT tooth lead angles shown, respectively.
[0041] Next, an operation is explained along with the flow chart for control of drawing 1 .
[0042] if the program for control of the control means 112 of said air-fuel ratio control system 110 starts (202) -- 2OO2 sensor output voltage VO2 sensor - of said O2 sensor 108 -- rich -- it judges whether it is more than /Lean judging electrical-potential-difference XO2RL (204).
[0043] And when this decision (204) is YES, an engine speed Ne, the inhalation air pressure (it is also called a "IMMANI pressure") Pb, and the amount VTA of VVT tooth lead angles are read (206), and three P.I. gain maps shown in (a) - (c) of drawing 2 , respectively are searched (208).
[0044] moreover, O2 sensor - which set the proportion (skip) component KP to "-P" (P: proportion (skip) gain) (210), computed integral component sigmaKIn according to formula sigma KIn=sigma KI(n-1)-II:integral gain (212), and was mentioned above after retrieval processing (208) of a P.I. gain map -- rich -- it returns to

decision (204) whether it is more than /Lean judging electrical-potential-difference XO2RL.
[0045] In addition, O2 feedback correction factor CFB which is said amount of feedback amendments is computed by formula CFB=1.0+ KP+sigma KI, and injector actuation time amount is found by the product of O2 feedback correction factor CFB and basic injection time.
[0046] Furthermore, when decision (204) whether it is or not is NO more than RL [O2 sensor Rich / Lean judging electrical-potential-difference XO2RL] it mentioned above, an engine speed Ne, the inhalation air pressure (it is also called a "IMMANI pressure") Pb, and the amount VTA of VVT tooth lead angles are read (214), and three P.I. gain maps shown in (a) - (c) of drawing 2 , respectively are searched (216).
[0047] O2 sensor - which set the proportion (skip) component KP to "+P" (P: proportion (skip) gain) (218), computed integral component sigmaKIn by formula sigma KIn=sigma KI(n-1)+I (220), and was mentioned above after retrieval processing (216) of this P.I. gain map -- rich -- it returns to decision (204) whether it is more than /Lean judging electrical-potential-difference XO2RL.
[0048] As this shows drawing 5 by said control means 112, the value of the amount VTA of VVT tooth lead angles which is the amount of tooth lead angles of valve timing takes for becoming large, while amendment width of face of O2 feedback correction factor CFB which is the amount of feedback amendments can be gradually made small and the amount of fluctuation of an air-fuel ratio does not become large, the deflection width of face of an air-fuel ratio also becomes small, generating of a surge can also be controlled, and it is advantageous practically.
[0049] Moreover, by having considered the amount of feedback amendments computed by said control means 112 as the configuration which consists of a proportion component and an integral component, a control top can also only carry out easily that the value of a proportion component or an integral component may be changed according to the amount VTA of VVT tooth lead angles which is the amount of tooth lead angles of valve timing, and responsibility is also good, and it can contribute to improvement in the goods force.
[0050] Drawing 6 and drawing 7 show the 2nd example of this invention.
[0051] The same sign is attached and explained to the part which achieves the same function as the thing of the 1st above-mentioned example in this 2nd example.
[0052] The place by which it is characterized [of this 2nd example] is in the point of having set up the VTA amendment table which asks for a VVT integral gain correction factor and a VVT proportional gain correction factor with the amount VTA of VVT tooth lead angles.
[0053] That is, as a VTA amendment table is shown in drawing 7 (a), two, what calculates the VVT integral gain correction factor CVTA from the amount VTA of VVT tooth lead angles, and the thing which calculates the VVT proportional gain correction factor CVTAP from the amount VTA of VVT tooth lead angles as shown in drawing 7 (b), are prepared. At this time, the amount VTA of VVT tooth lead angles takes each VTA amendment table for increasing, and it is set up that it should decrease gradually.
[0054] Since fluctuation of the torque over air-fuel ratio fluctuation is smaller than the time when the amount VTA of VVT tooth lead angles is large, when the direction when the amount VTA of VVT tooth lead angles is small in general multiplies the integral gain of O2 feedback, and proportional gain by the correction factor which can be found from the amount VTA of VVT tooth lead angles, at the time of a low tooth lead angle, it is large, and is conversely small at the time of a rise angle, and each gain is controlled.
[0055] Here, an operation is explained along with the flow chart for control of drawing 6 .
[0056] if the program for control of the control means of said air-fuel ratio control system starts (302), while reading (304) of the amount VTA of VVT tooth lead angles will be performed, retrieval (306) of a VTA amendment table carries out -- having -- 2OO2 sensor output voltage VO2 sensor - of O2 sensor -- rich -- it judges whether it is more than /Lean judging electrical-potential-difference XO2RL (308).
[0057] And when this decision (308) is YES, the proportion (skip) component KP is made into "-CVTAP-P" (a CVTAP:VVT proportional-gain correction factor, P: proportion (skip) gain) (310), and it returns to reading (304) of the amount VTA of VVT tooth lead angles which computed and (312) mentioned integral component sigmaKIn above according to formula sigma KIn=sigma KI(n-1)-CVTA-II:integral gain.
[0058] Moreover, it sets to decision (308) whether O2 sensor output voltage VO2 of O2 above-mentioned sensor is more than O2 sensor Rich / Lean judging electrical-potential-difference XO2RL. When this decision (308) is NO, the proportion (skip) component KP is made into "+CVTAP-P" (314), and it returns to reading (304) of the amount VTA of VVT tooth lead angles which computed and (316) mentioned integral component

sigmaKIn above by formula sigma KIn=sigma KI(n-1)+CVTA-I.
[0059] If it strokes, like the thing of the 1st example of ****, the value of the amount VTA of VVT tooth lead angles which is the amount of tooth lead angles of valve timing takes for becoming large by said control means, while amendment width of face of O2 feedback correction factor CFB which is the amount of feedback amendments can be gradually made small and the amount of fluctuation of an air-fuel ratio does not become large, the deflection width of face of an air-fuel ratio also becomes small, generating of a surge can also be controlled, and it is advantageous practically.
[0060] Moreover, by having considered the amount of feedback amendments computed by said control means like the thing of the 1st example of **** as the configuration which consists of a proportion component and an integral component, a control top can also only carry out easily that the value of a proportion component or an integral component may be changed according to the amount VTA of VVT tooth lead angles which is the amount of tooth lead angles of valve timing, and responsibility is also good, and it can contribute to improvement in the goods force.
[0061]
[Effect of the Invention] A fuel-injection means to supply a fuel to an internal combustion engine according to this this invention as explained to the detail above, In the internal combustion engine air-fuel ratio control system equipped with an adjustable valve timing means by which the bulb overlap period which both an air-fuel ratio detection means to detect an air-fuel ratio, and an intake valve and an exhaust air bulb open can be changed While establishing the control means controlled in order to compute the amount of feedback amendments for amending the amount of basic control based on the value from an air-fuel ratio detection means and to bring a actual air-fuel ratio close to a target air-fuel ratio Since the function which the value of the amount of tooth lead angles of valve timing takes for becoming large, and makes small gradually amendment width of face of the amount of feedback amendments was added and prepared in this control means While the value of the amount of tooth lead angles of valve timing can take for becoming large, and can make small gradually amendment width of face of the amount of feedback amendments and the amount of fluctuation of an air-fuel ratio does not become large by the control means, the deflection width of face of an air-fuel ratio also becomes small, generating of a surge can also be controlled, and it is advantageous practically.

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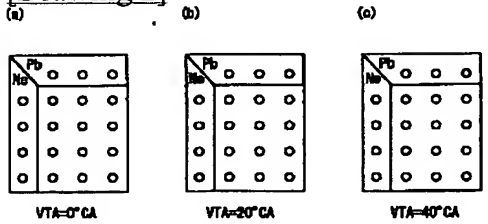
* NOTICES *

DRAWINGS

[Drawing 2]



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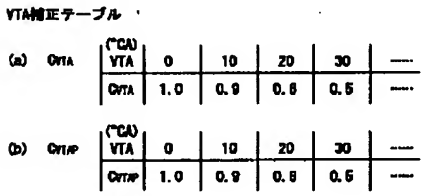

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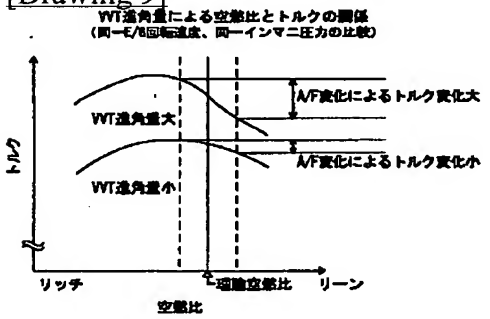
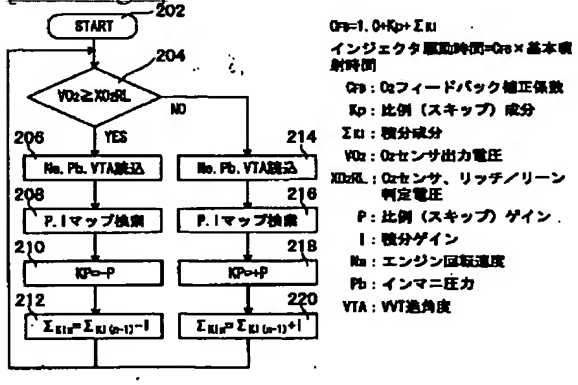


[Drawing 1]



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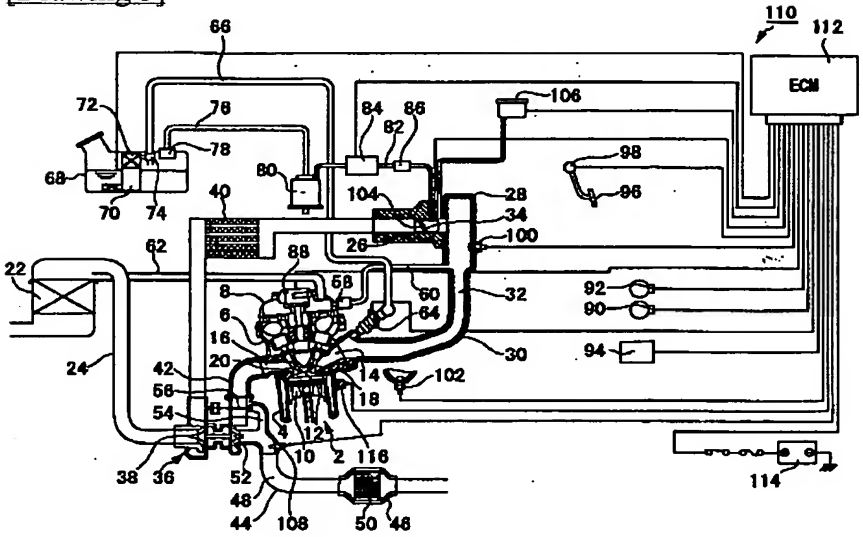

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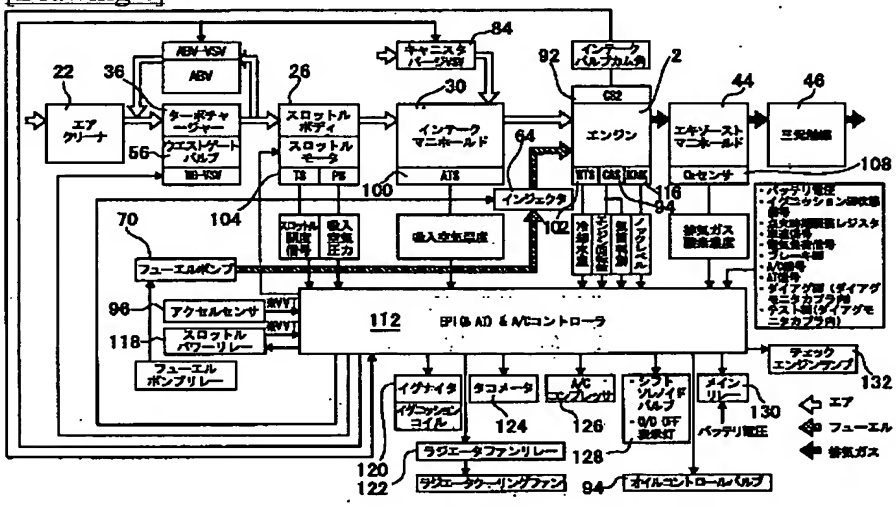
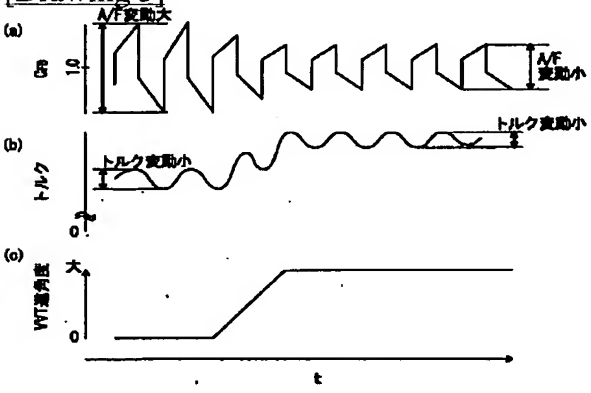


[Drawing 5]



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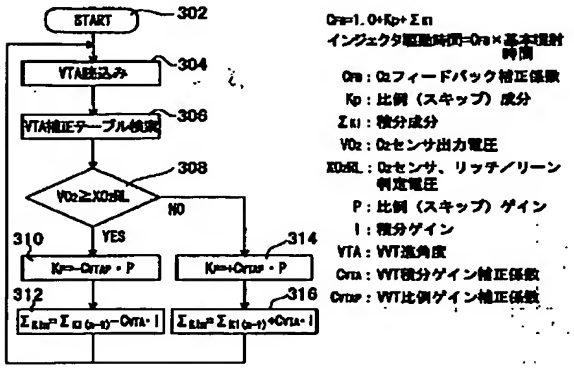

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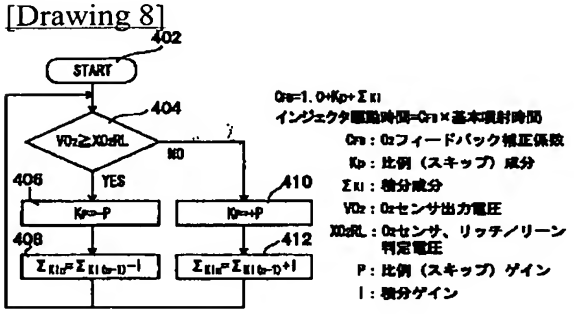
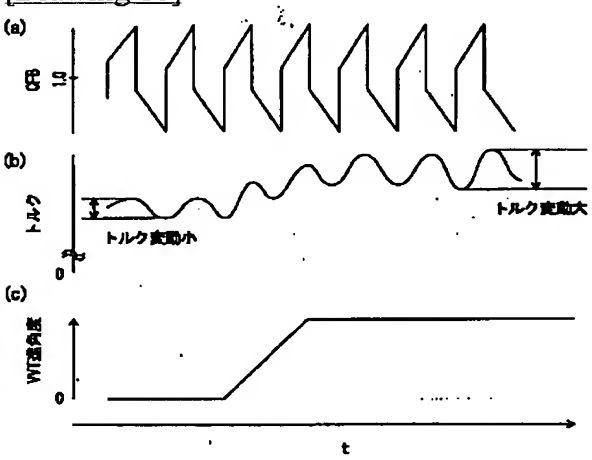


[Drawing 10]



[Translation done.]

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